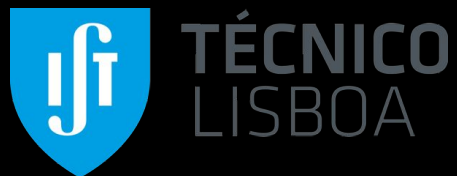


Smart Sound Monitoring



ElectroCap Pitch Deck





Team

Afonso Cruz

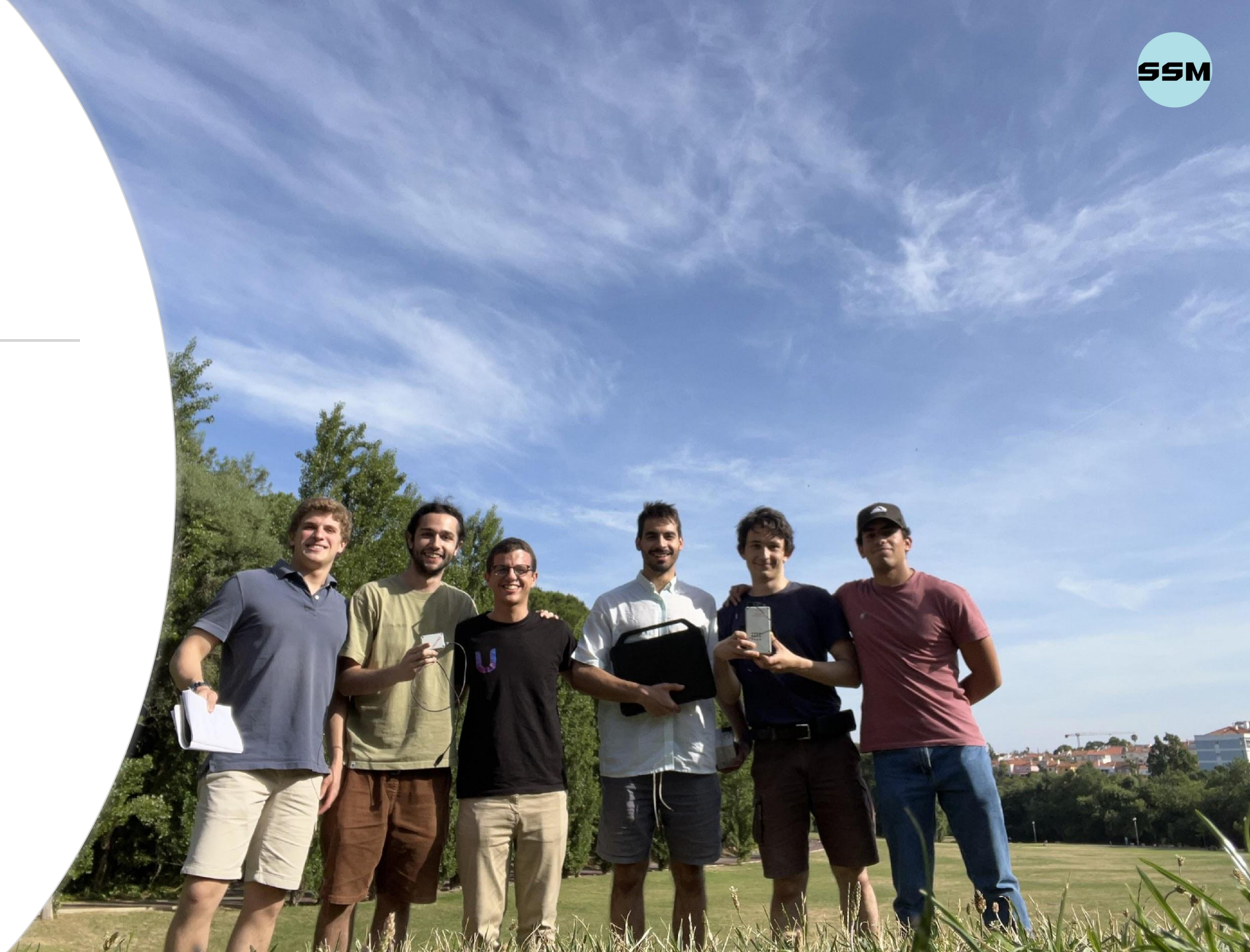
Carlos Reis

Frederico Paula

Gonçalo Lázaro

Nuno Jorge

Pedro Martins





Advisors and Mentors

Prof. Luís Caldas de Oliveira



Prof. Rafael Cordeiro



Problem definition

- As outdoor concerts and festivals get bigger and bigger and the number of this type of events continues to grow, a problem arises.
- The methods to comprehensively map and analyse the sound quality and characteristics of these spaces need to adapt.
- Our goal is to provide valuable insight into the acoustic environment, identifying problems and potential improvements. We focus on facilitating the whole process by providing a reliable device which anyone can use.





Our solution

- Our project consists, essentially, in a **portable** sensor that transmits data to a graphical user interface (designed by us) in **real-time**.
- The sensor module captures audio information accurately even from a **long distance** to the sound source. By coupling it to a processing unit, our product provides **precise decibel level readings**. Moreover, the user can easily analyze the frequency spectrum of the signal through our **user-friendly** interface.

Solution beneficiaries

- **Event Organizers and Planners:** Improved event planning and management, enhanced sound quality, and real-time monitoring capabilities to address issues promptly. Better and easier logistics and staff management.
- **Sound Engineers and Technicians:** Detailed acoustic analysis and data, tools for optimizing sound systems, and insights into improving sound distribution and quality without leaving the control booth.
- **Performers and Artists:** Assurance of high-quality sound delivery and better audience engagement.
- **Attendees/Audience:** Enhanced experience, clearer and more balanced sound and an overall more enjoyable event.
- **Local Communities:** Reduced noise pollution, minimized disturbance from events, and better relationships between residents and event organizers.



Competitors and previous work

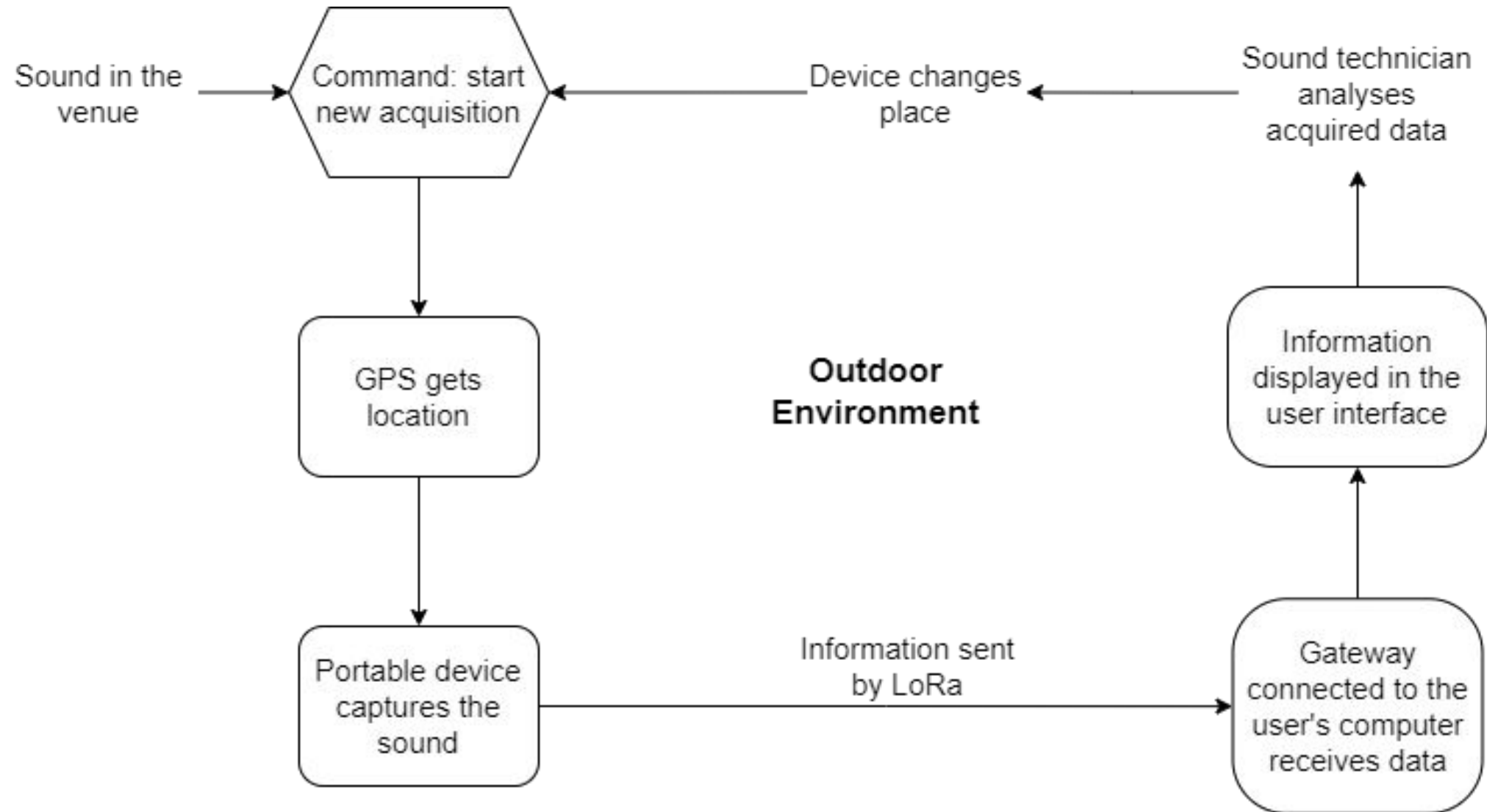
Previous Solution	Issues Found	Our Solution
Ghent University	Multiple fixed position sensors	Arbitrary number of mobile sensors
d&b ArrayCalc simulation software	No location measurement Focus on simulation	Location measurement Real-time acquisitions



Challenges

- Making sure the wireless modules provide **accurate data**, regarding both the acquired signal and the location of the device.
- Having a reliable and robust **communication** system between the different modules.
- Providing **real-time data**, allowing an instant analysis and response to changes of the sound.
- Developing an **affordable, easily commercialized** and **user-friendly** product.
- Developing a product that can be **adaptable** to various situations and auxiliar technologies.
- Inherent complexity of outdoor acoustics, influenced by multiple factors such as weather, crowd size, noise, etc.

Flowchart

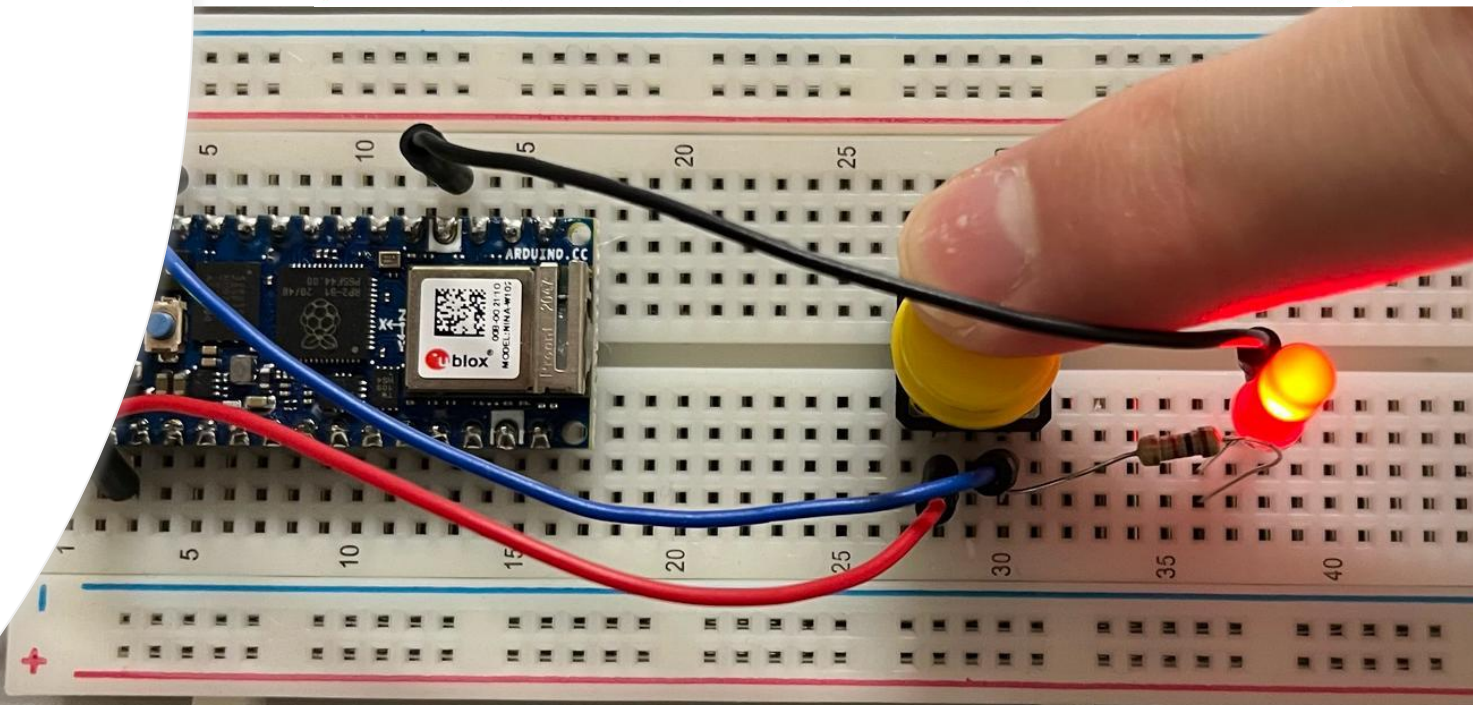
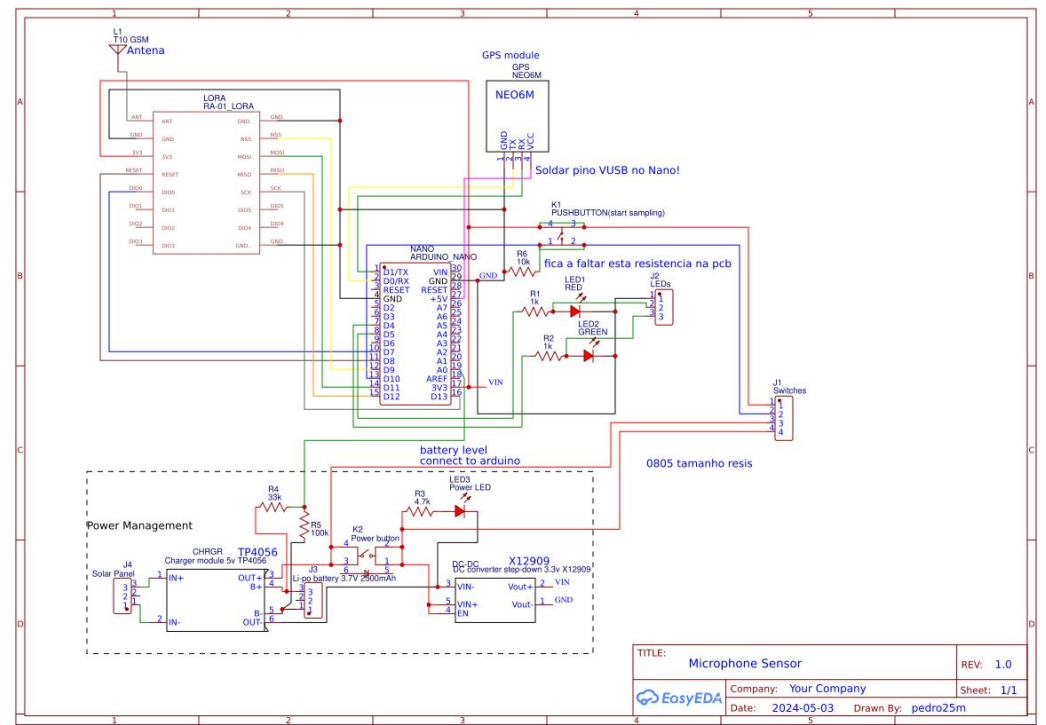


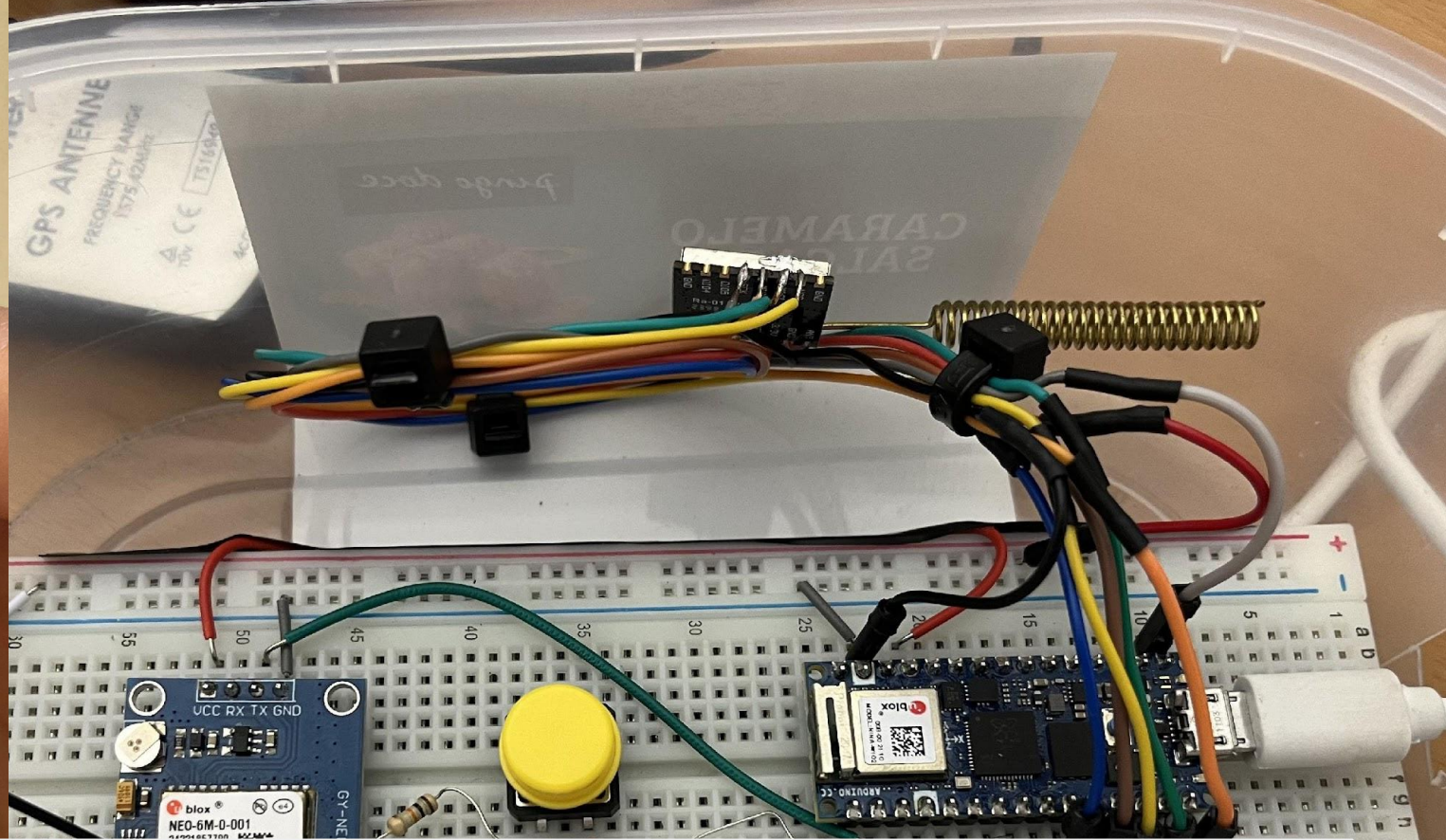
Data acquisition



Arduino Nano RP2040
Connect with a built-in
MP34DT06JTR
microphone

Auxiliary button and
indicative LEDs





Data
transmission

LoRa technology implementation



Location measurement

- GPS



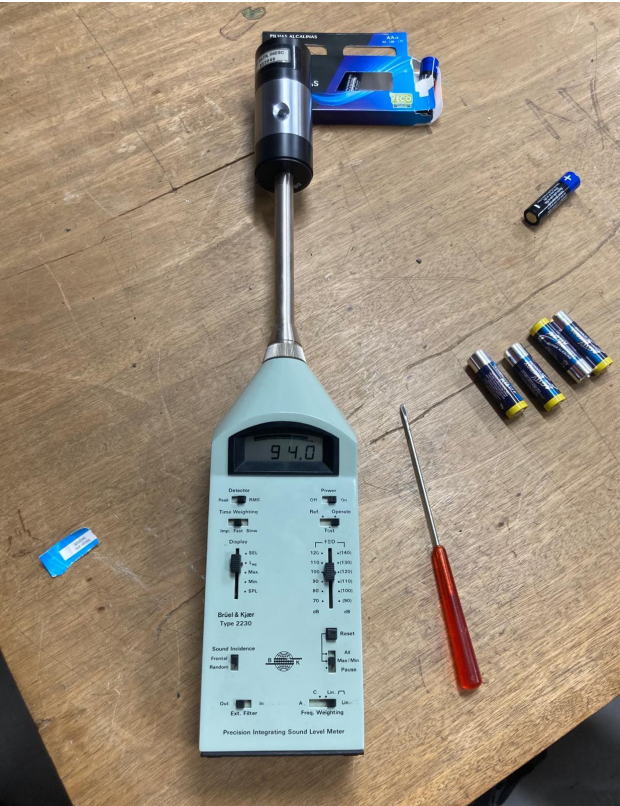
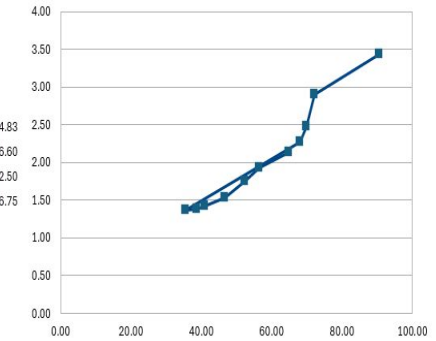
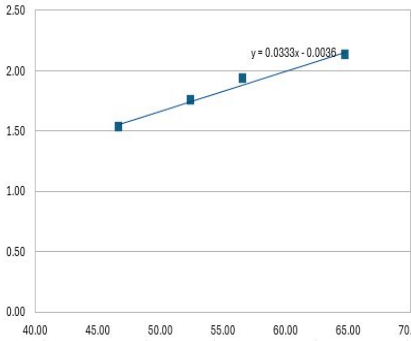


Microphone calibration

- Conversion to dB
- Sound level meter
- Final error < 1%

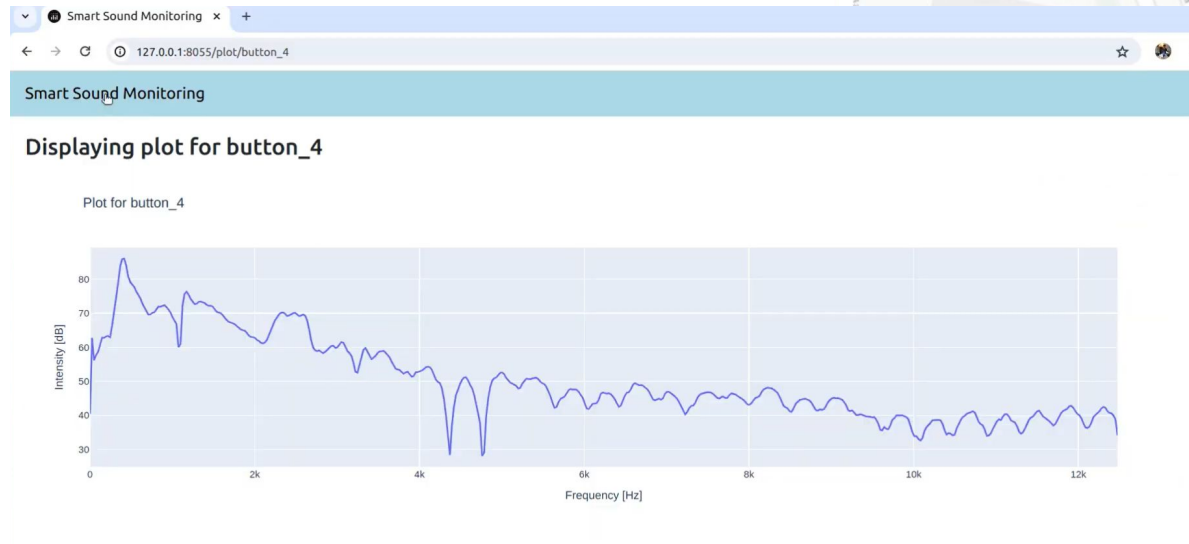
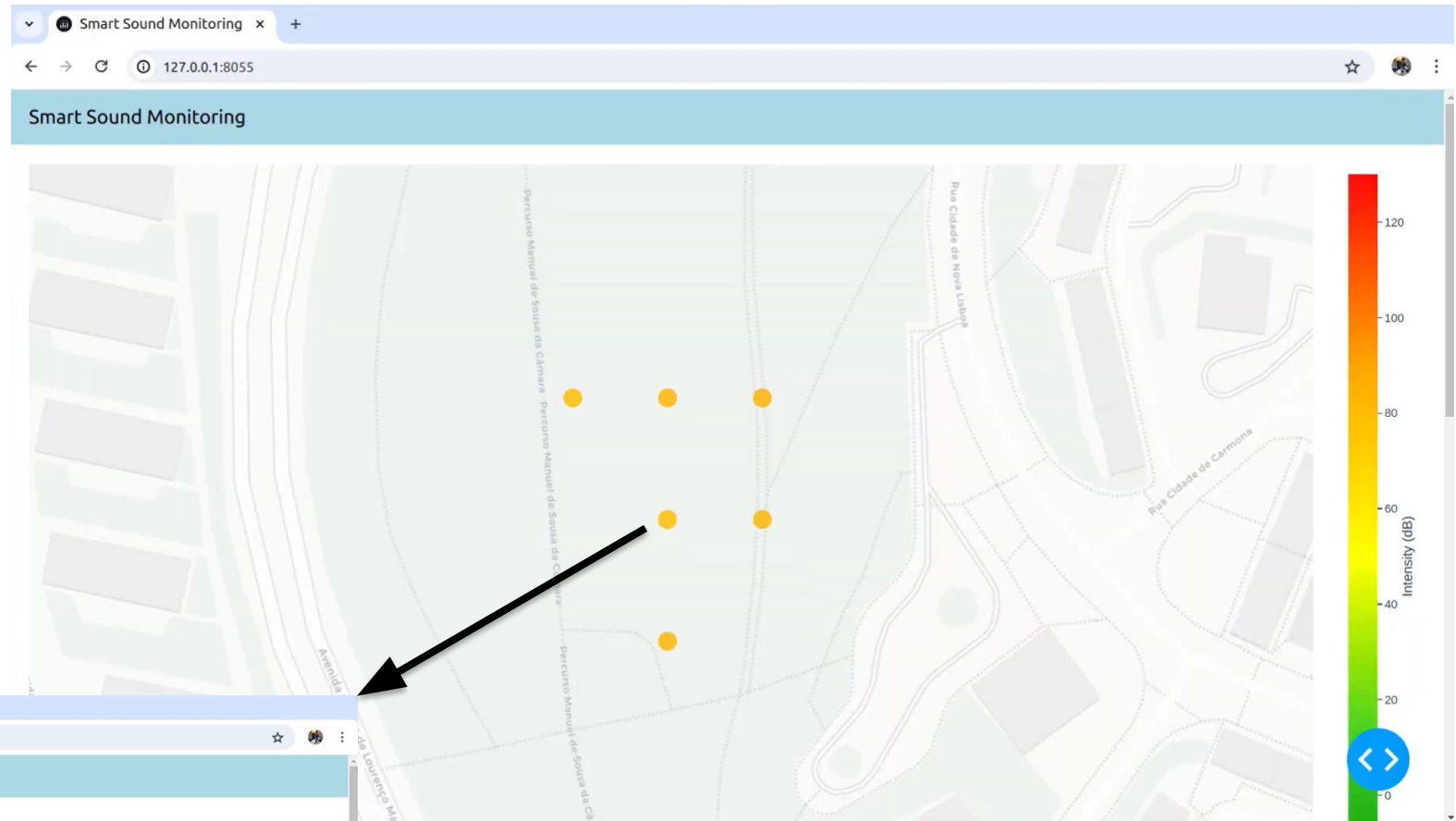
Calibrar microfona PIC		Y = aX + b			
A = soma X ²	39778.46	a	0.04	ks	25.80
B = soma X	637.03	b	-0.19	CC	-0.19
C = soma 1	11.00				
D = Soma XY	1419.40				
E = Soma Y	22.58				

MEMS	X = SON	Y = log(MEMS)	X ²	XY	Teste	ERRO (%)	ERRO_MEDIO
	134.23	64.83	2.13	4202.28	137.94	59.86	7.67
	84.98	56.60	1.93	3203.56	109.20	54.73	3.30
	55.94	52.50	1.75	2756.25	91.76	50.05	4.67
	33.82	46.75	1.53	2185.56	71.49	44.41	5.01
	26.05	41.05	1.42	1685.10	58.12	41.48	1.06
	24.23	38.70	1.38	1497.69	53.57	40.67	5.10
	23.17	35.55	1.36	1263.80	48.52	40.17	13.00
	184.19	68.15	2.27	4644.42	154.38	63.40	6.97
	300.10	69.90	2.48	4886.01	173.16	68.87	1.47
	796.57	72.30	2.90	5227.29	209.76	79.81	10.39
	2719.21	90.70	3.43	8226.49	311.50	93.57	3.16



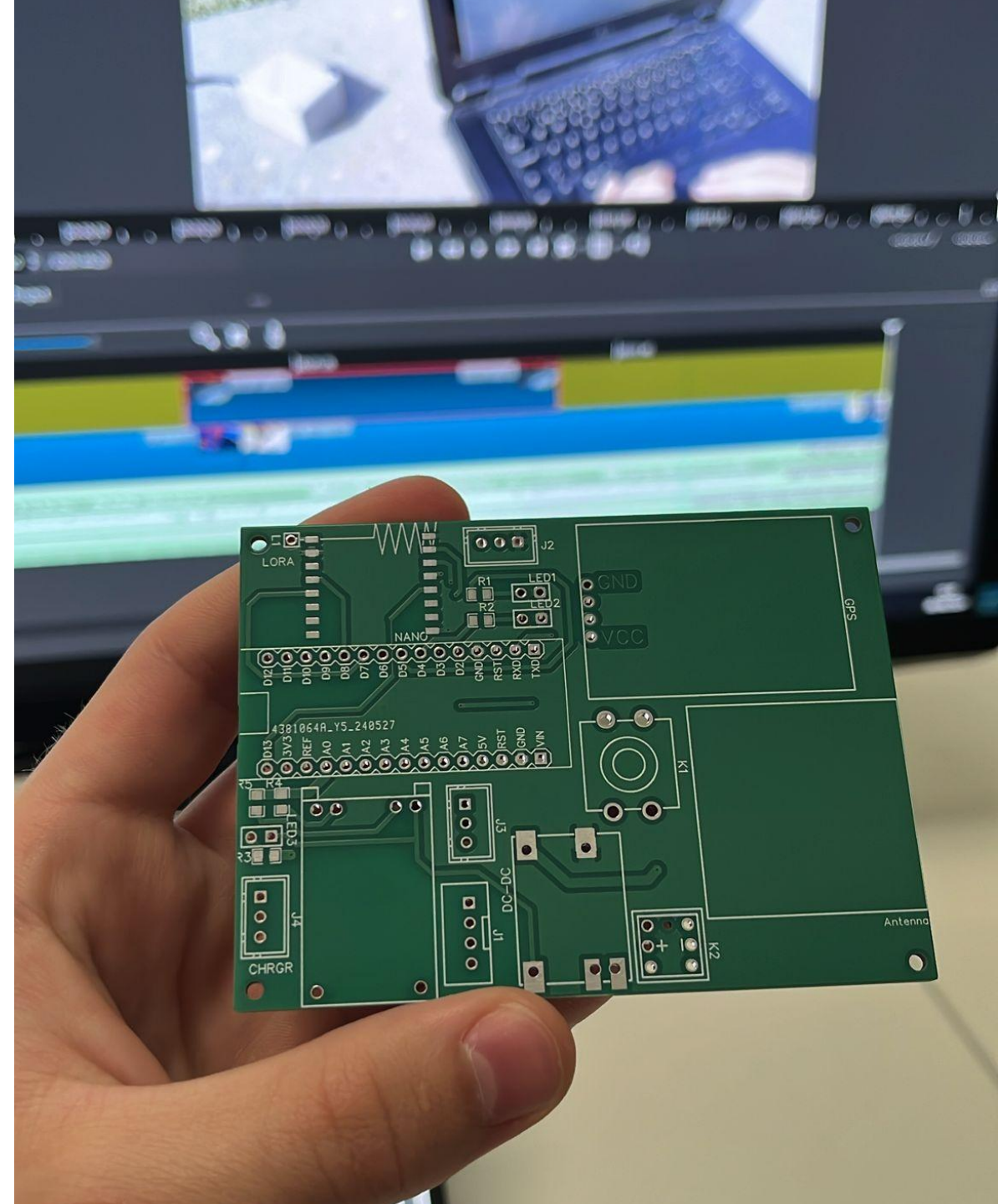
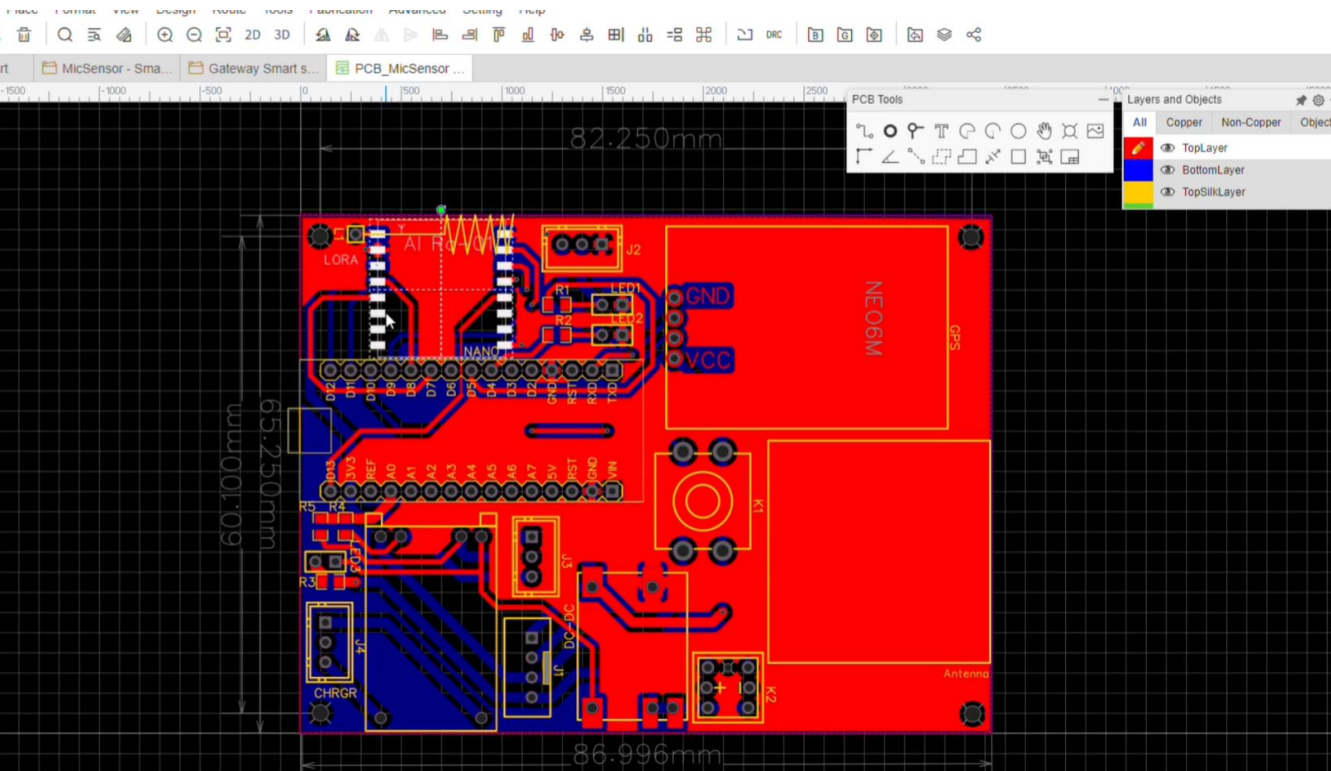
User interface

- Display power spectrum
- Show location on map
- Maximum sound level



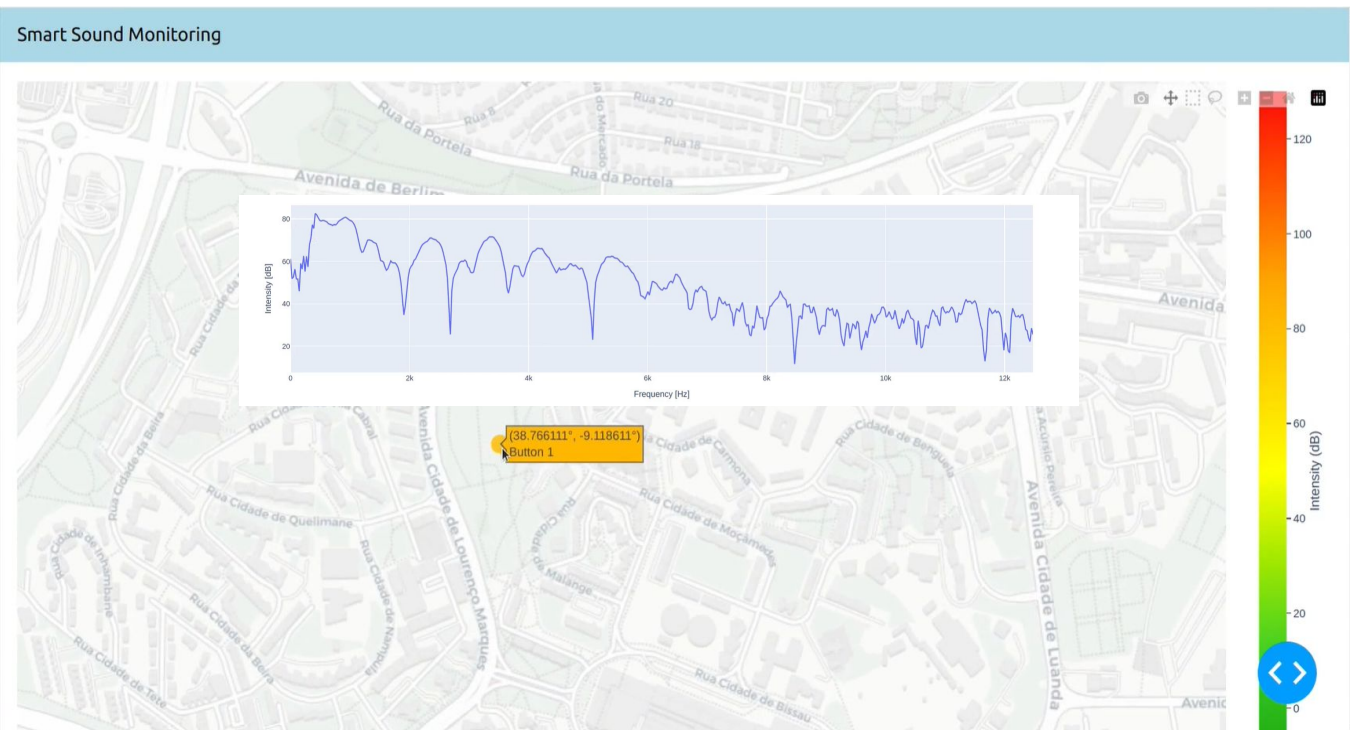
PCB

- Development of a printed circuit board to install the electronics.



Testing and results

- Successful test day.
- Accurate readings of sound intensity (dB) and respective frequency spectrum for multiple points in an outdoor space, where concerts often take place.



Contribution of each team member (1)

Afonso Cruz	Carlos Reis	Frederico Paula
Interface	Data acquisition	Communications
Data processing	Microphone calibration	Data processing
Code management	Blog writing	Interviews
Meeting scheduling	Prototype testing	Research
User interface	Poster designing	LoRa

Contribution of each team member (2)

Gonçalo Lázaro	Nuno Jorge	Pedro Martins
Data acquisition	Interface	Communications
Research of previous solutions	Established partnership	Team coordination
First testings	Website development and monitoring	Interview and Research
Data acquisition	Blog entries	GPS
Microphone calibration	User interface	Hardware



Business Case for Smart Sound Monitoring (SSM)



Costs – Overview

Arduino Nano RP2040 Connect:
15 – 26 €

GPS Module:
10 – 20 €

LoRa Module:
3 – 9€

Battery and BMS:
10 – 12€

Additional Components and Accessories:
10€

Total estimated cost per SSM Unit:
48 – 67 €

Benefits

01

Enhanced Event Management:

- Real-time adjustments and monitoring ensure high-quality sound delivery.
- Mitigates the impact on surrounding communities, fostering better relations and compliance with regulations.

02

Operational Efficiency:

- **Collection and Analysis:**
Facilitates quick decision-making and problem-solving during events.
- Affordable and scalable monitoring system for large outdoor events.

03

Data-Driven Insights:

- Helps identify areas for improvement, leading to better future events.
- Ensures balanced and clear sound, enhancing satisfaction and engagement.

04

Community Relations:

- Effective noise management fosters better relationships with local residents and authorities.
- Compliance with noise level regulations, avoiding potential fines and issues.

Market potential

Target Audience (reference to slide 6):

- Event Organizers and Planners
- Sound Engineers and Technicians
- Performers and Artists
- Concert Venues and Festivals
- Municipalities and Local Authorities

Market Size:

- The global live event market is projected to grow significantly, with increasing demand for quality sound management solutions.
- Outdoor events, concerts, and festivals are major contributors to this growth, creating a substantial market for SSM units.